Mars Image Processing on Cluster Computers

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Abstract:
As JPL embarks upon an era of surface mission operations (landers and rovers), the need for timely (i.e. near real-time) delivery of derived products to aid in science and operations planning activities is crucial. Examples of such telemetry-derived products are: terrain models, panoramic mosaics, and 3-D rendered animations, all of which are used by two different, but overlapping, customers: science and mission operations. While the science user is trying to understand and visualize the latest data acquired (usually to prepare for an imminent press conference), the mission planning activities are focused on generating sequences for the very next day of operations. Both user communities require use of the latest information immediately after the receipt of the most recent downlinked telemetry. We have met this challenge by developing parallelized processing code to be run on Beowulf configured commercial-off-the-shelf (COTS) hardware. This has lead to a drastic reduction in the time required to generate these products.
Two distinct applications have been tackled first: 1) the generation of mosaics for a large set of individual images, and 2) the pixel correlation in stereo image pairs. Almost ideal scaling performance with increasing number of utilized CPUs on midsize clusters of up to 64 CPUs have been obtained for both algorithms. Such performance reduced the required computing time from about 90minutes per task to about 3-4 minutes. The parallelization of the image correlation did not only decrease the required CPU time but also provided increased convergence stability. The dramatic reduction in required CPU time in the correlation algorithm enabled for the first time in a realistic production environment to perform a correlation tie-point quality control.
Hardware, methods, and results on our work on mosaicing, image correlation, and image correlation quality control will be discussed in the presentation.